serves. The author of the present volume set out to remedy this deficiency by making adequate study of a little region near Karlstadt-on-the-Main, where the sandstone with its green woods and red, moist soil gives place to limestone and a dry, glistening white soil.

In similar instances it has been the practice to attribute the difference of flora to the presence of calcium carbonate in the limestone soil and its absence from the sandy soil, and the author began with this hypothesis in view by making numerous determinations of calcium carbonate in the soil. But he was soon driven to the conclusion that calcium carbonate is an exceedingly variable quantity; indeed, he doubts whether any estimate can be obtained of the amount in the layers of the soil immediately in contact with the plant root. Making the determination in the accepted way, however, and comparing the analytical results with the vegetation, he failed to find any plant that occurred exclusively on soils of even approximately the same calcium carbonate content; there were always variations within very wide limits. A vague relationship only could be traced: some plants showed a clear preference for soils containing a high amount of calcium carbonate, whilst others were found on soils containing only small quantities. Thus *Festuca glauca* occurred on soils containing 28 to 64 per cent., *Teucrium montanum* on soils containing 11 to 73 per cent.—more generally, however, when more than 35 per cent. was present—and *Melica ciliata* where 24 to 60 per cent. occurred. Against these the limits for *Brachypodium pinnatum* were 2 to 43 per cent., for *Koeleria cristata* 1·4 to 27 per cent., and for *Hieracium pilosella* 16 to 56 per cent.

A mixed flora was found where the limestone merged into the sandstone. True chalk plants like *Pulsatilla* and *Hippocrepis* grew in spots where calcium carbonate was absent, while calcifugous plants like *Calluna* and *Vaccinium* were found in places where more than 3 per cent. of calcium carbonate occurred, and alongside *Anemone sylvestris* flourished. With the exception of a few plants that require large amounts of calcium carbonate the author seems to have found most of the local calcicolous plants on soils entirely free from calcium carbonate. He has completely lost faith in the lime content of the soil as a true basis of discrimination, and looks forward to the time when every calcicolous plant shall have been found on chalk-free soils.

The wandering of plants for which calcium carbonate is supposed to be essential on to chalk-free soils has been already observed, but never accounted for. When exceptions to a rule begin to crop up, there is a strong temptation to invent a new name to describe the exceptional case and after a while to take the name as an explanation of the phenomenon, and the cynic might argue that something of the sort has happened with the word invented in this instance—heterotopism. The present author, however, goes further; since the calcium carbonate hypothesis fails, he turns to a second hypothesis, the view that the physical properties of the soil and not the calcium carbonate really determine the distribution of plants. The particular set of properties best suited to calcicolous plants are usually found in soils rich in calcium carbonate, while those suited to calcifugous plants are associated with soils poor in calcium carbonate; but the carbonate itself does not play the controlling part in the matter. The author is not prepared to say that calcium carbonate exerts no specific action on the plant, but he knows of no proof that it does. Even small quantities of calcium carbonate are known to affect markedly the properties of the soil; he therefore made mechanical analyses, determined water-contents and temperatures of the soils, and also noted their aspects and general relation to their surroundings. Working over very small areas in great detail, he finds distinct similarity in general physical conditions on spots where the same plants are growing. In the last instance the physical properties of the soil are some function of the soil structure, which therefore he considers to be the determining factor.

Whether the author's conclusions are wholly justified can only be ascertained by further experiments, but he certainly makes out a strong case for his main thesis that the botanist must pay more attention to the properties of the soil if he wishes to account for the distribution of plants. The book will be found of much interest to ecologists as a piece of painstaking and methodical work, and it emphasises the important fact that careful investigation over a limited area is likely to prove very fruitful in the study of ecology.

E. J. RUSSELL.

THE ADVANCE OF PHOTOGRAPHY.

The Advance of Photography: its History and Modern Applications. By A. E. Garrett. Pp. xiii + 382. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1911.) Price 12*s*. 6*d*. net.

IT is about forty years since Dr. Hermann Vogel wrote his volume entitled "The Chemistry of Light and Photography in their Application to Art, Science, and Industry" for the "International Scientific Series," so well known by their red covers. The copy before us is a "new and revised" edition issued in 1876, and about two-fifths of its contents are devoted to historical

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facts and processes, two-fifths to the applications of photography, including photo-mechanical methods, while the remaining fifth is devoted to the action of light, the correctness of photographs, perspective, &c., with a final chapter on "Photography as a subject to be taught in art and industrial schools." In this last chapter Dr. Vogel makes an earnest plea for the inclusion of photography in the courses of study of technical institutions, not "to train professional photographers . . . but so far as it is of importance for art and science." He bases his plea, not only on the opinions of others, but also on his nine years' experience as professor of photography in the Royal Industrial Academy of Berlin.

This is the book that Mr. Garrett has sought to modernise, or "bring up to date," as the saying is. The present author has given the volume a new title, transferred Vogel's name from the title-page to the preface, and states that "although the present book is of necessity practically a new work, it is based upon the lines laid down in the original publication." The only noteworthy omission of the substance of the original volume that we observe is the last chapter, that is the plea for the consideration of photography as a subject to be included in the curriculum of colleges, because of the importance and the universality of its applications. Perhaps the author is justified, for, in this country at least, there is little "advance" to record with regard to this matter. The study of photography, even by those who need its aid, too often means no more than working from the instructions issued by manufacturers, with perhaps an occasional question across the dealer's counter.

The remainder of the volume is rearranged somewhat and added to. The chief additions are on gelatino-bromide dry plates (which, of course, were not in use when Vogel wrote), photography in natural colours, Röntgen-ray photography, photo-telegraphy, and animated photography. These final chapters are interesting, instructive, and well illustrated, though they sometimes wander rather far from photography, as, for example, in the consideration of the apparatus used in Röntgen ray work. When a matter such as this is treated and illustrated so fully, we naturally expect that the more purely photographic subjects will have received at least as much attention, but here we are disappointed. Within the space of four pages there is all that we can find with regard to carbon printing, the gum bichromate process, ozobrome (ozotype is not mentioned), printing-out papers, toning and fixing, phosphate papers, bromide printing, gas-light papers, and platinum printing!

Lenses are classified into (1) rapid rectilinears, (2) portrait lenses, (3) wide angle lenses, and, as a kind of supplement, telephoto lenses. All that we can find about Abbé and Schott, and the optical work they carried out which has revolutionised the construction of photographic lenses, is that when they "undertook to construct a lens suitable for this work," that is, exact work, "they had the very great advantage of having a definite aim in view."

The author's style is generally clear, but there are some sentences which need a little expansion or explanation, because as they stand they are liable to mislead the reader. For example, at p. 323 we are told that

> "the superiority of apochromatic lenses in microphotographic work is only very apparent when the preparation to be photographed is unstained, and extremely minute details are required such as can only be resolved with light of short wavelength. Hence it is that the cheaper achromatic lenses are much more frequently used in conjunction with stained preparations, autochrome plates, or orthochromatic plates and colour screens."

The unqualified statement that it is "essential" to have a stand of "a large type and provided with a rotating and centering stage" for the purposes of photomicrography, appears to us to be contrary to general experience. When such matters as these are elucidated, the volume will be an interesting and useful treatise, though it can scarcely claim to be comprehensive.

C. J.

THE GRAMMAR OF SCIENCE.

The Grammar of Science. By Prof. Karl Pearson, F.R.S. Part i., Physical. Third edition, revised and enlarged. Pp. xx + 394. (London. A. and C. Black, 1911.) Price 6*s.* net.

THE notices formerly given of the first and second editions of Prof. Pearson's well-written "Grammar of Science" (see NATURE, vol. 46, pp. 97–99, 1892, and vol. 62, pp. 49–50, 1900) scarcely need to be added to in the way of a general review. The main feature of the new edition which differentiates it from the others is the addition of two new chapters: chapter v., on contingency and correlation, and chapter x., modern physical ideas. The former chapter is particularly noteworthy, presenting as it does in a wonderfully small compass the scientific significance of the two terms contingency and correlation. The general reader, whose mathematical symbolism is of the most elementary type, will probably find difficulty in appreciating the full scope of this chapter. A simple concrete example might not have proved amiss.

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